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Six *Typhula* spp. newly recorded from Türkiye

Sedat Kesici[1], Mustafa Emre Akçay[2*],
Cemil Sadullahoğlu[3], Yusuf Uzun[4]

[1] *Department of Plant and Animal Production, Yüksekova Vocational High School, Hakkari University, 30300, Yüksekova, Hakkari, Türkiye*

[2] *Department of Biology, Faculty of Science, Van Yüzüncü Yıl University, 65080, Van, Türkiye*

[3] *Department of Veterinary, İdil Vocational High School, Şırnak University, 73300 İdil, Şırnak, Türkiye*

[4] *Department of Pharmaceutical Botanic, Faculty of Pharmacy, Van Yüzüncü Yıl University, 65080, Van, Türkiye*

* Correspondence to: *memreakcay@gmail.com*

Abstract—Macrofungi samples were collected during routine field studies in 2019 within the borders of Hakkari and Şırnak provinces, Türkiye. Six *Typhula* species were collected for the first time from Türkiye: *T. corallina*, *T. crassipes*, *T. incarnata*, *T. micans*, *T. phacorrhiza*, and *T. quisquiliaris*. Detailed descriptions of the species are presented with morphological and microscopic illustrations and ecological information.

Key Words—*Agaricales*, *Typhulaceae*, taxonomy

Introduction

Typhula (Pers.) Fr. has clavarioid basidiocarps that arise from sclerotia or directly from mycelia, typically with amyloid spores and dextrinoid hyphae (Ikeda & al. 2015, Olariaga & al. 2016). Characters that delimit *Typhula* from other clavarioid genera are small basidiomata, often with a corticate stipe and the presence of caulinar hairs or gelified hyphae (Olariaga & Salcedo 2009).

Typhula species produce fruitbodies that are slender, filiform, or clavarioid and white, yellow, pink, brownish, or reddish (Kaygusuz &

Çolak 2017). Typhuloid fungi are one of the taxonomically most under-researched groups of *Basidiomycota*, likely because their tiny basidiomata are overlooked by mycologists (Olariaga & al. 2016).

According to the online databases (http://www.indexfungorum.org and https://www.mycobank.org), around 80 *Typhula* species have been described worldwide. In Türkiye, five species—*T. erythropus* (Pers.) Fr., *T. fistulosa* (Holmsk.) Olariaga, *T. juncea* (Alb. & Schwein.) P. Karst., *T. spathulata* (Corner) Berthier, *T. setipes* (Grev.) Berthier—have been identified by previous researchers (Solak & al. 2007, Sesli & al. 2016, Kaygusuz & Çolak 2017, Uzun & al. 2017, Işık 2020).

The current Turkish checklist (Sesli & al. 2020) and recent studies (Berber & al. 2021, Acar & al. 2021, Sesli 2021, Uzun 2021a,b, Şelem & al. 2021, Çetinkaya & Uzun 2021, Akata & al. 2021, Altuntaş & al. 2021) do not report *T. corallina*, *T. crassipes*, *T. incarnata*, *T. micans*, *T. phacorrhiza*, and *T. quisquiliaris*, which are cited here as new records for the mycobiota of Türkiye.

The study aims to present new distribution localities for *Typhula* species and contribute to the macrofungal diversity of Türkiye.

Materials & methods

Fresh basidiomata of *Typhula* species were collected from Hakkari and Şırnak provinces, Türkiye, during field studies in 2019. Collected specimens were photographed in situ using a Canon (EOS 60D) camera equipped with Tokina 100 mm macro lens. Macromorphological characters were recorded based on field notes and coloured photographs of fresh fruiting bodies. Micro-morphological characteristics of dried specimens were examined after sectioning and rehydration. Microscopic observations were made using a Leica DM500 research microscope. Micrographs were captured with a Leica ICC50 HD camera and measured with Leica Application Suite (version 3.4.0). The reagents 5% KOH and iodine (IKI) were used as investigation media. At least 30 spores and 15 basidia from six samples in distilled water and KOH were measured for each recorded species. The specimens were identified after consulting the literature (Remsberg 1940, Corner 1950, Berthier 1976, Breitenbach & Kränzlin 1986, Hansen & Knudsen 1997, Wojewoda 2000, Olariaga & Salcedo 2005, Buczacki & al. 2012, Olariaga & al. 2020). Collected samples were deposited as voucher specimens in Fungarium of Van Yüzüncü Yıl University, Van, Türkiye (VANF).

Taxonomy

Typhula corallina Quél., C.r. Assoc. Franç. Avancem. Sci. 11: 396 (1883) Fig. 1

Sporophores 0.5–8 mm long, more or less curved, usually tapering towards the tip (some tips lanceolate), without hairs, whitish in color, with a slightly delimited stipe and clavula; clavula 0.5–5 mm long, cylindrical to narrowly claviform, with obtuse to acute apex. Stipe 0.5–3 mm long, cylindrical, straight, or curved, glabrous, one to 6–7 sporophores developing from a single sclerotium. Sclerotia 0.5–2 mm diam., lobed, ovoid to irregular, with a smooth surface, ocher to reddish-brown, dark brown to blackish when dry, gel-like inside, rarely absent.

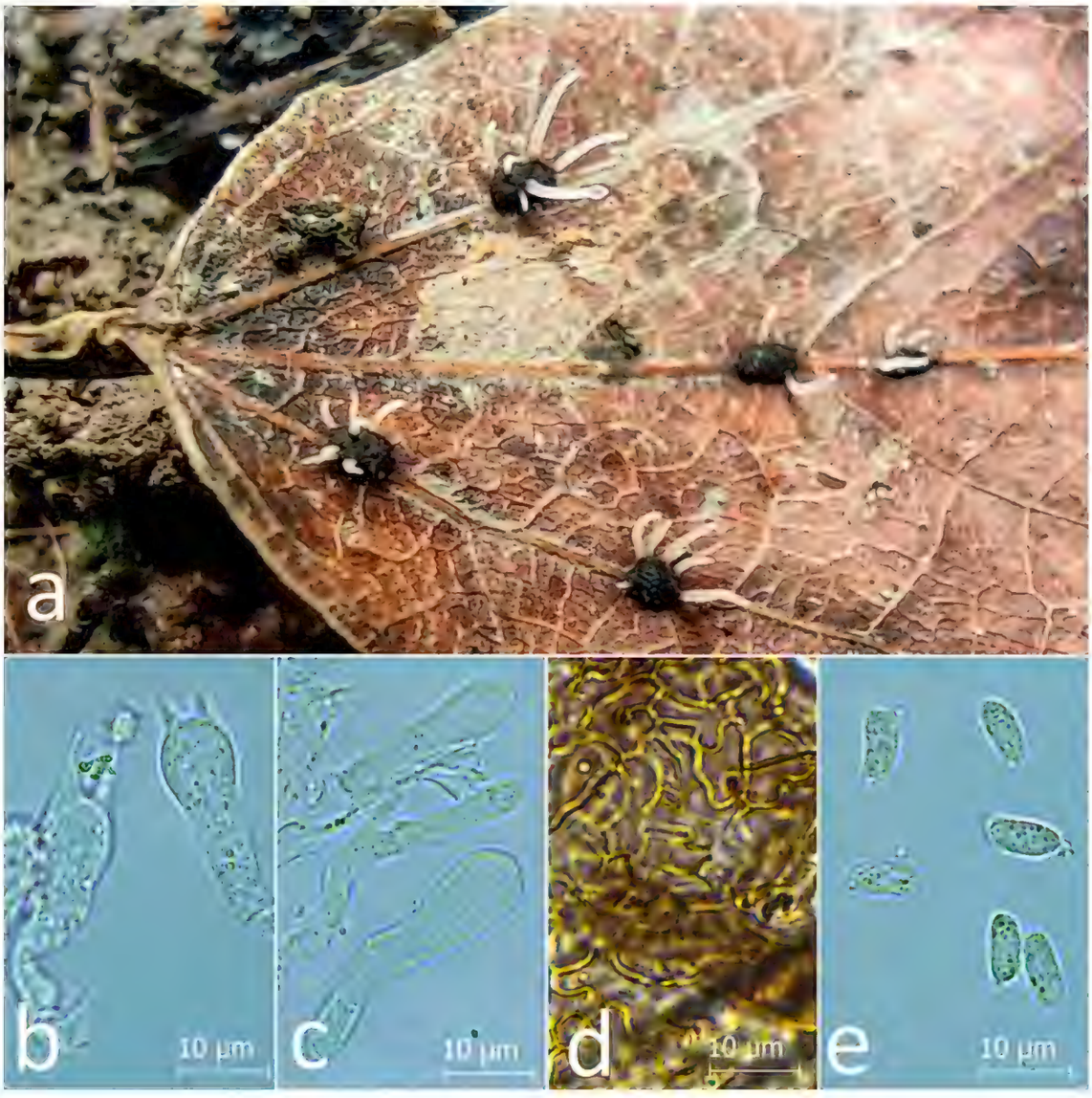

Fig. 1. *Typhula corallina* (VANF 7883):
a. Basidiomata; b. Basidia; c. Basidioles; d. Epidermoid cells of sclerotium; e. Basidiospores.

Basidiospores 6–10 × 4–5 µm, elongated ellipsoid, smooth, hyaline, thin-walled, with an ambiguous apiculus. Basidia 26–38 × 6.5–9 µm, clavate, with 2–4 sterigmata, without basal clamp.

Specimens examined—**TÜRKIYE, Hakkari, Central district,** neighborhood of Merzan, 37.5699°N 43.7217°E, 1791 m, on leaf remnants of *Populus* sp., 14.07.2019 Kesici (VANF 7883); **Durankaya town**, 37.5554°N 43.6174°E, 1693 m, on remains of *Xanthium strumarium* L., 03.11.2019 Kesici (VANF 7884).

Habitat: Usually growing gregariously on very diverse decaying plant remains such as herbaceous stems, horsetail ferns (*Equisetum* sp.) and leaves (Corner 1950, Berthier 1976).

Comments—Although the basidiospores of the collections cited above are very close to the description of Olariaga & Salcedo (2005), they are larger than those cited by Corner (1950) and Requejo & Castro (2015). Berthier (1976) stated that sometimes there is no sclerotium; similarly we did not find sclerotia in some of our specimens.

Macroscopically, *T. corallina* is characterized by its sporophores with undifferentiated stipe and clavula that are usually fasciculate or aggregated. Microscopically, the absence of clamps and differentiated hairs on the stipe are useful characters in its identification. Sporophores of *T. crassipes*, which are also aggregated and glabrous, are distinguished by yellowish to light-brown sclerotia and relatively longer sporophores (Corner 1950, Berthier 1976, Olariaga & Salcedo 2005).

Typhula crassipes Fuckel, Jb. Nassau. Ver. Naturk. 23–24: 32 (1870) Fig. 2

Sporophores 2–15 mm long, filiform, unbranched, straight or often curved to form a hook shape, equal or somewhat tapering towards the tip, without hairs, whitish in color, with a slightly delimited stipe and clavula, clavula 2–10 mm long, smooth, cylindrical to club-shaped, blunt at tip. Stipe 0.5–5 mm long, indistinct, cylindrical, glabrous, usually more than one sporophore (≤10–11) develop from a single sclerotium. Sclerotia 1–3 mm diam., on or embedded in substrate, ovoid to irregular, with a smooth surface, pale ocher to light-brown, gel-like inside, rarely absent.

Basidiospores 6–10.5 × 4.5–6 µm, elongated ellipsoid, smooth, hyaline, thin-walled, with an ambiguous apiculus. Basidia 25–40 × 7–9 µm, clavate, with 2–4 sterigmata, without basal clamp.

Specimen examined—**TÜRKIYE, Şırnak, Uludere district,** formerly Hilal town, 37.2827°N 42.4650°E, 1017 m, on branch remnants of *Rubus idaeus* L., 15.11.2019 Kesici (VANF 7885).

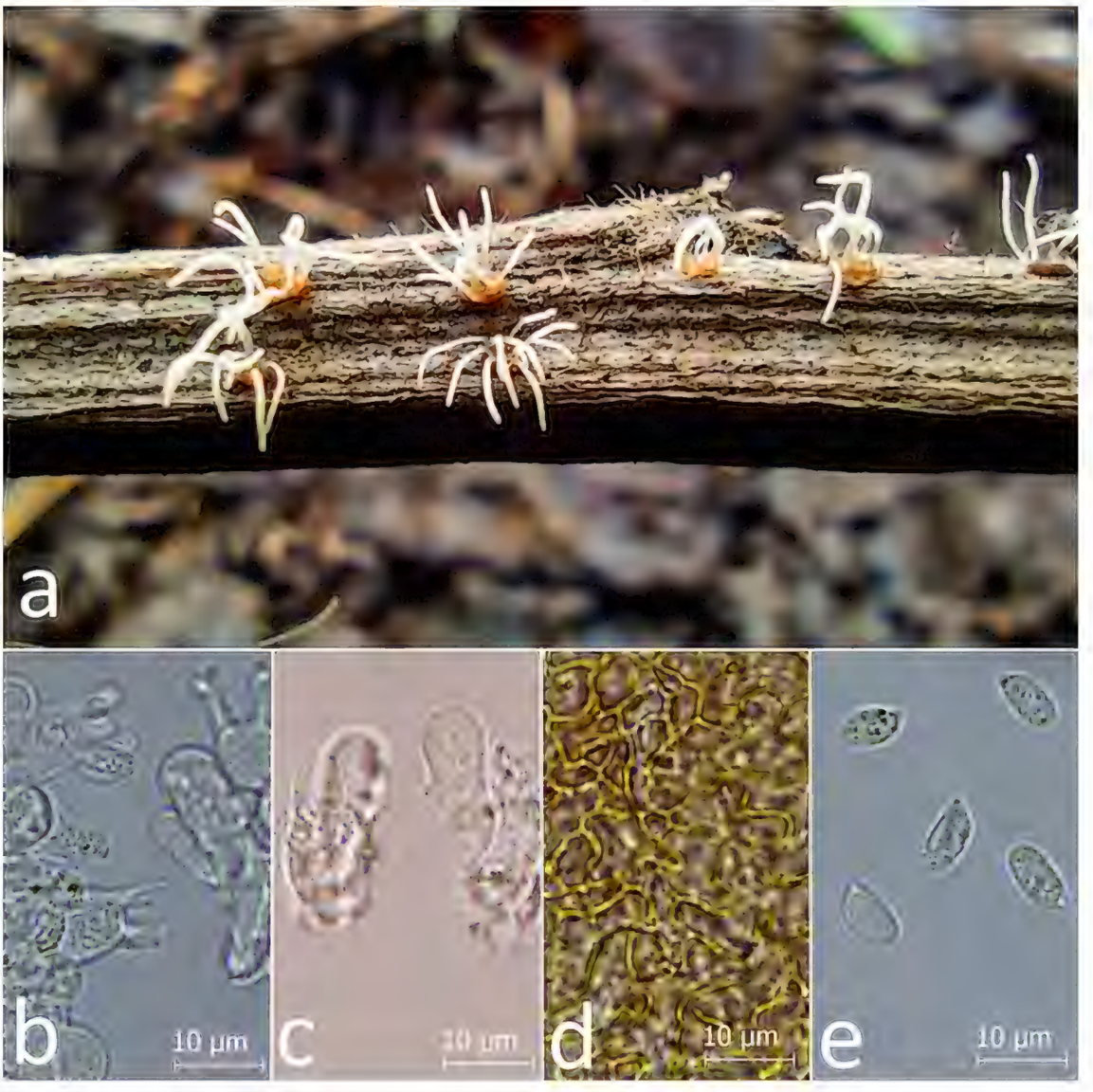

Fig. 2. *Typhula crassipes* (VANF 7885):
a. Basidiomata; b. Basidia; c. Basidioles; d. Epidermoid cells of sclerotium; e. Basidiospores.

Habitat: Grows usually gregariously on dead, fallen and rotting leaves and herbaceous stems (Buczacki & al. 2012, Hansen & Knudsen 1997).

Comments—The ecological and morphological characteristics of the collection above agree with Hansen & Knudsen (1997) and Buczacki & al. (2012). Although macroscopically similar to *Typhula corallina, T. crassipes* is distinguished by its sclerotia that are lighter in color and often embedded in the substrate, a greater number of sporophores developing from a single sclerotium, and relatively longer sporophores (Buczacki & al. 2012, Hansen & Knudsen 1997).

Typhula incarnata Lasch ex Fr., Epicr. Syst. Mycol.: 585 (1838) FIG. 3

SPOROPHORES 5–35 mm long, filiform, unbranched, straight, or slightly curved towards to tips, with a clear separation between stipe and clavula, clavula 5–10 mm long, distinctly pink, smooth, slightly wider than the stipe, cylindrical to club-shaped, blunt at tip. STIPE 5–30 mm long, filiform, short hispid especially towards to bottom, whitish with pink tinge becoming pale brown, one or more (usually one) sporophore arising from each sclerotium. SCLEROTIA 1–3 mm diam., on surface of the host, rounded to oblong, with a smooth surface, pale brown to hazel-brown, partially gel-like inside.

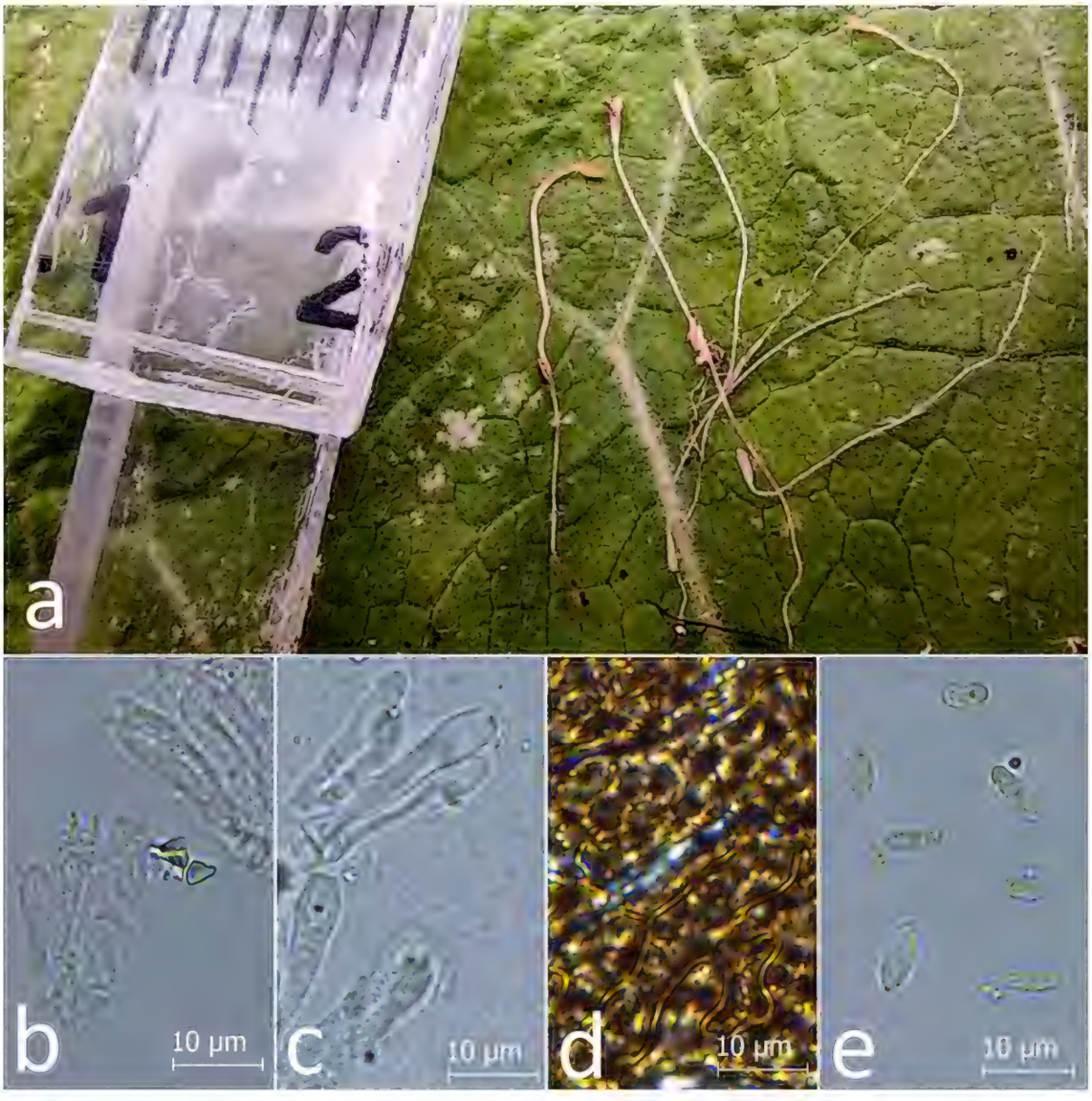

FIG. 3. *Typhula incarnata* (VANF 7886):
a. Basidiomata; b. Basidia; c. Basidioles; d. Epidermoid cells of sclerotium; e. Basidiospores.

Basidiospores (6–)7–11 × 3–5 µm, elongated ellipsoid, flattened on one side above a pointed apiculus, smooth, hyaline, thin-walled, weakly amyloid. Basidia 25–35 × 4–7 µm, narrowly clavate, with 2–4 sterigmata.

Specimen examined—**TÜRKIYE, Hakkari, Central district,** neighborhood of Merzan, 37.5699°N, 43.7219°E, 1791 m, on decaying plant remains, 26.10.2019 Kesici (VANF 7886).

Habitat: Grows solitary or in small troops on dead grass leaves in late autumn; parasitic on natural and cultivated grasses and cereals, causing "grey snow mold" (Buczacki & al. 2012, Hansen & Knudsen 1997).

Comments—While basidiospores of the collection cited above agree in size with those cited by Hansen & Knudsen (1997); they are slightly larger than the measurements given by Berthier (1976), Corner (1950) and Hoshino & al. (2004). *Typhula graminum* P. Karst., which also parasitizes and causes disease on a variety of herbaceous plants, produces completely white sporophores and lacks pinkish tones. Although *T. micans* sporophores do have pinkish colors, the absence of a sclerotium easily distinguishes it from *T. incarnata* (Remsberg 1940, Buczacki & al. 2012, Hansen & Knudsen 1997).

Typhula micans (Pers.) Berthier, Bull. Mens. Soc. Linn. Lyon 45: 172 (1976) Fig. 4

Sporophores 1–3 mm long, filiform, unbranched, very soft and fragile, pink to lilaceous, separation between stipe and clavula obvious; clavula 0.5–2.5 mm long, cylindrical to slightly irregular, usually circular in cross-section, blunt at tip, smooth or finely floury under magnifying glass. Stipe very short, rudimentary but evident and distinct from clavula. Sclerotia absent.

Basidiospores 8.5–11 × 5–6.5 µm, ellipsoid to ovoid, with an ambiguous apiculus, smooth, hyaline, thin-walled, amyloid. Basidia 30–45 × 5–8 µm, slenderly clavate, with 2–4 sterigmata, basal clamp present.

Specimen examined—**TÜRKIYE, Hakkari, Çukurca district,** Köprülü village, 37.5699°N 43.7219°E, 1791 m, on decaying plant remains, 26.10.2019 Kesici (VANF 7887).

Habitat: Grows solitary or in small troops on rotting herbaceous stems in autumn (Buczacki & al. 2012, Hansen & Knudsen 1997).

Comments—Basidiospores of the specimens cited above are slightly shorter than cited by Buczacki & al. (2012) and Hansen & Knudsen (1997). *Typhula micans* differs from *T. incarnata* (also with pinkish sporophores) which is distinguished by the presence of a sclerotium. *Typhula uncialis* (Grev.)

Berthier, which also does not form a sclerotium and is similar in appearance to *T. micans,* can be distinguished by its white sporophores and shorter spores (Berthier 1976, Buczacki & al. 2012, Hansen & Knudsen 1997).

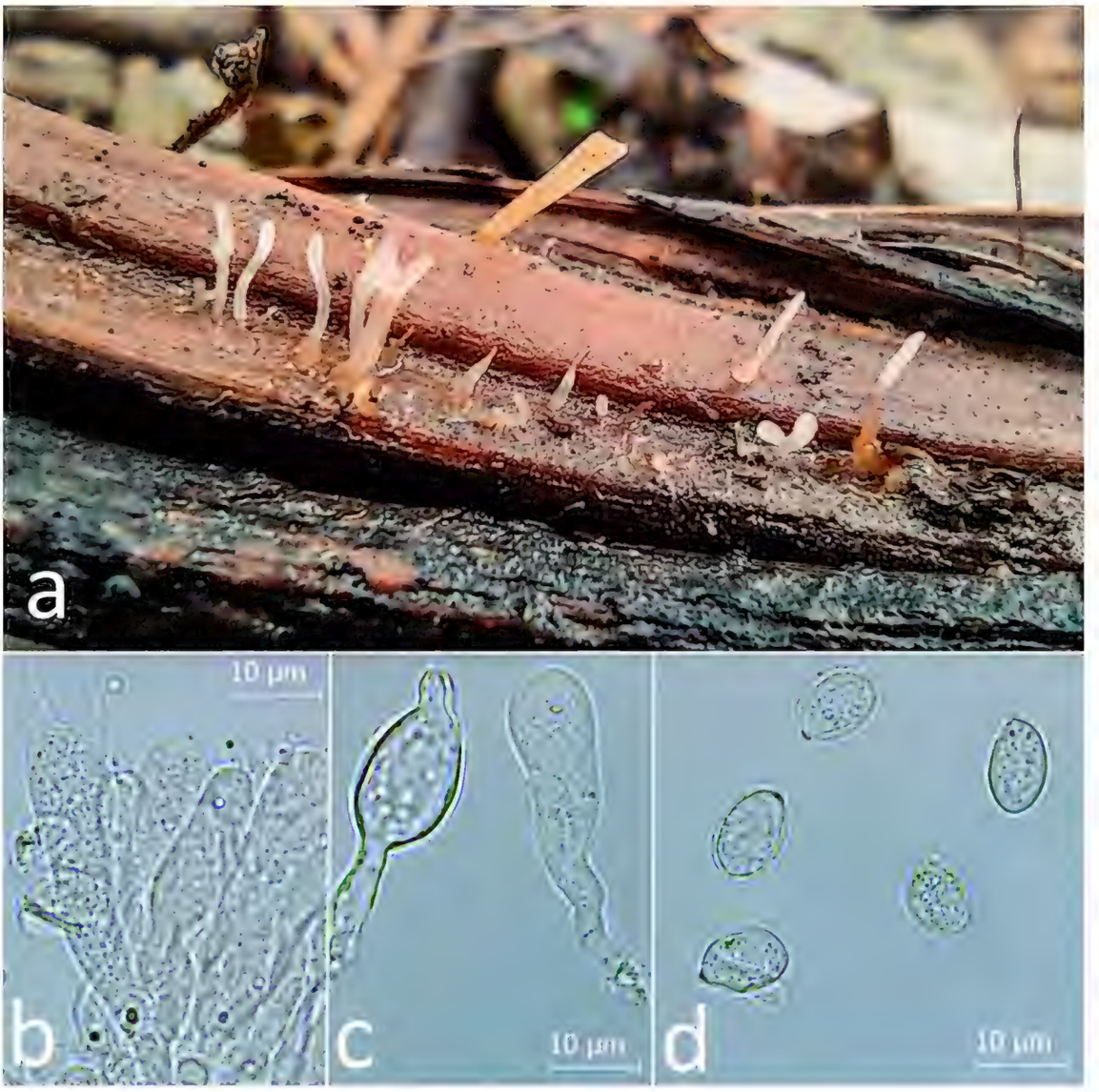

Fig. 4. *Typhula micans* (VANF 7887):
a. Basidiomata; b. Basidia; c. Basidioles; d. Basidiospores.

Typhula phacorrhiza (Reichard) Fr., Observ. Mycol. 2: 298 (1818) Fig. 5

Sporophores 20–95 × 0.5–1 mm, filiform, elastic, tough, straight or slightly curved, somewhat branched, apex usually acute, tapering below into a long filiform stipe, distinguishing between stipe and clavula is difficult except at maturity, translucent when young, later honey brown to reddish-brown, somewhat darker towards to apex, upper third smooth and fertile,

under third and also blunt tips sterile, pubescent at the bottom, one or more growing from any point on the sclerotium, sometimes arising directly from the mycelium. Sclerotia 2–5 × 0.5–1 mm, lobed and irregular disc-shaped, cinnamon-brownish, smooth at first, then wrinkled, gel-like inside, sometimes 2–3 sporophores developing from a single sclerotium.

Basidiospores 10–14 × 5–7 µm, elongated ellipsoid, smooth, hyaline, thin-walled, with an unsharp apiculus. Basidia 17–24 × 7.5–9 µm, clavate, with 2-4 sterigmata, basal clamp absent. Caulocystidia 20–35 × 4–7 µm, clavate to cylindrical, hyaline, somewhat branched.

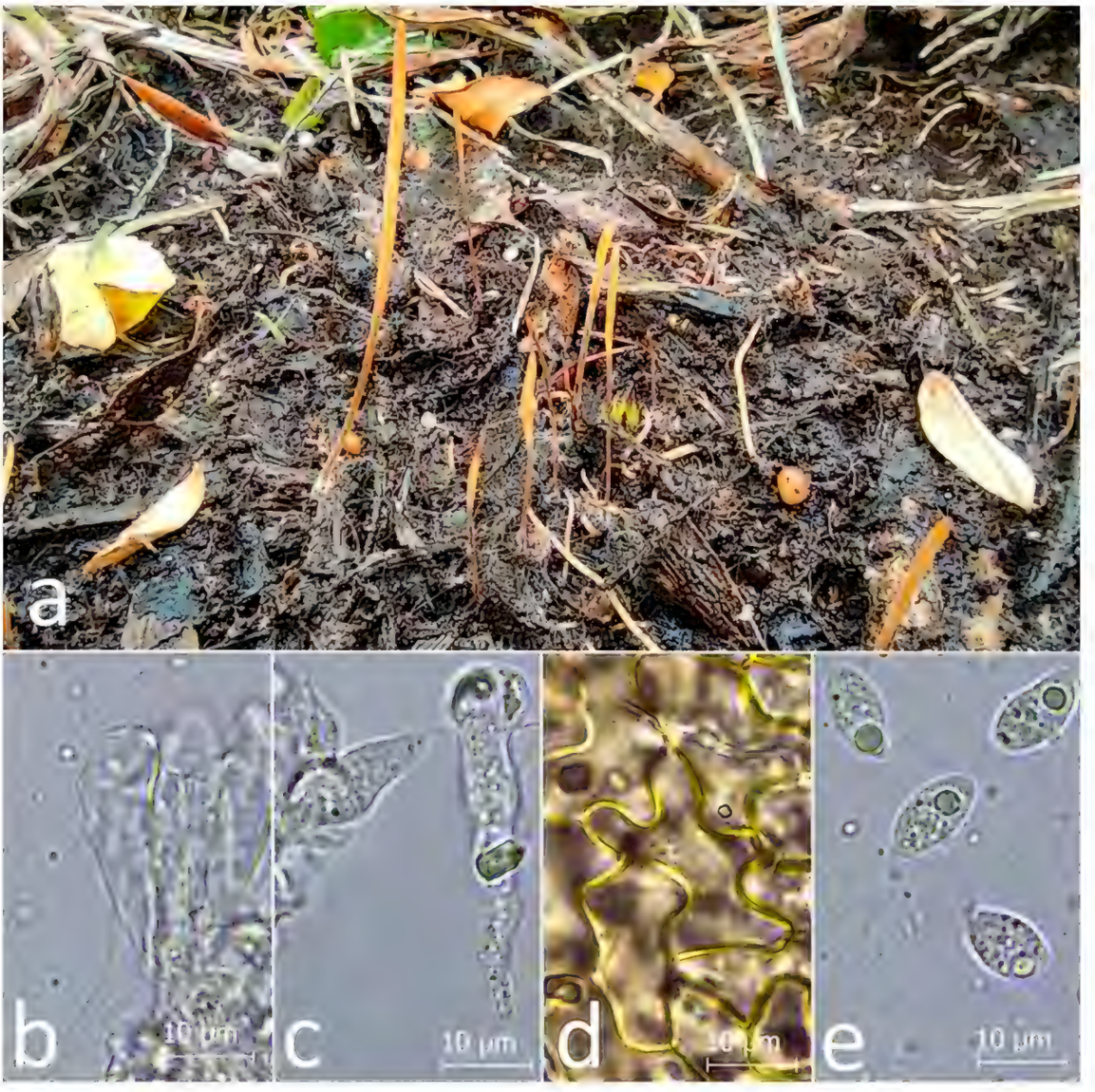

Fig. 5. *Typhula phacorrhiza* (VANF 7888): a. Basidiomata; b. Basidia; c. Caulocystidia; d. Epidermoid cells of sclerotium; e. Basidiospores.

Specimen examined—**TÜRKIYE, Hakkari, Central district,** neighbourhood of Merzan, 37.5699°N 43.7216°E, 1790 m, on rotten wood, 26.10.2019 Kesici (VANF 7888).

Habitat: Grows in clusters or groups on decaying leaves of varied broad-leaved trees in autumn (Breitenbach & Kränzlin 1986).

Comments—The sporophore length is given as 20-100 mm by Breitenbach & Kränzlin (1986) and 40-120 mm by Buczacki & al. (2012) and Hansen & Knudsen (1997), and the basidiospores of the specimens cited above are slightly shorter than the basidiospores in those three studies. *Typhula phacorrhiza* is morphologically very similar to *T. juncea*, but *T. juncea* does not have sclerotium and its spores are smaller (Breitenbach & Kränzlin 1986).

Typhula quisquiliaris (Fr.) Henn., Bot. Jahrb. Syst. 23: 288 (1896) Fig. 6

Sporophores 3–10 mm long, clavate to capitate or almost cylindrical, unbranched, whitish, arising from a sclerotium lying in the pith of the stem, stipe and clavula distinction is evident, clavula 2–6 mm long, ≤3 mm wide, clavate to capitate, usually circular in cross-section, blunt at tip, quite solid, smooth. Stipe 2.4–2.6 mm long, ≤1.5 mm wide, translucent whitish, finely pubescent. Sclerotia 2–3 mm long, ≤0.5 mm thick, yellowish to light brown, not gelatinized within. Scattered in rows along the ribs of the stems or longitudinal fissures, a single sporophore arising from each sclerotium.

Basidiospores 8.5–12 × 4–5.5 µm, ellipsoid to cylindrical, flattened on one side above a pointed apiculus, smooth, hyaline, thin-walled, amyloid. Basidia 35–55 × 6–8 µm, slenderly clavate, with 4 sterigmata, basal clamp present.

Specimen examined—**TÜRKIYE, Hakkari, Central district,** Durankaya town, 37.5549°N 43.6179°E, 1683 m, on rotten remains of *Urtica dioica* L., 03.11.2019 Kesici (VANF 7889).

Habitat: Grows usually gregariously on the dead stems and petioles of various herbaceous plants, especially on *Pteridium* species, in autumn. (Breitenbach & Kränzlin 1986, Wojewoda 2000, Buczacki & al. 2012, Hansen & Knudsen 1997).

Comments—The ecological and morphological characteristics of the Turkish specimens agree with Hansen & Knudsen (1997) and Buczacki & al. (2012). *Typhula quisquiliaris* may be confused with *T. uncialis* (also growing on dead herbaceous stems) and the similar-appearing *T. spathulata.* However, *T. uncialis* has no sclerotia and its spores are smaller and non-amyloid.

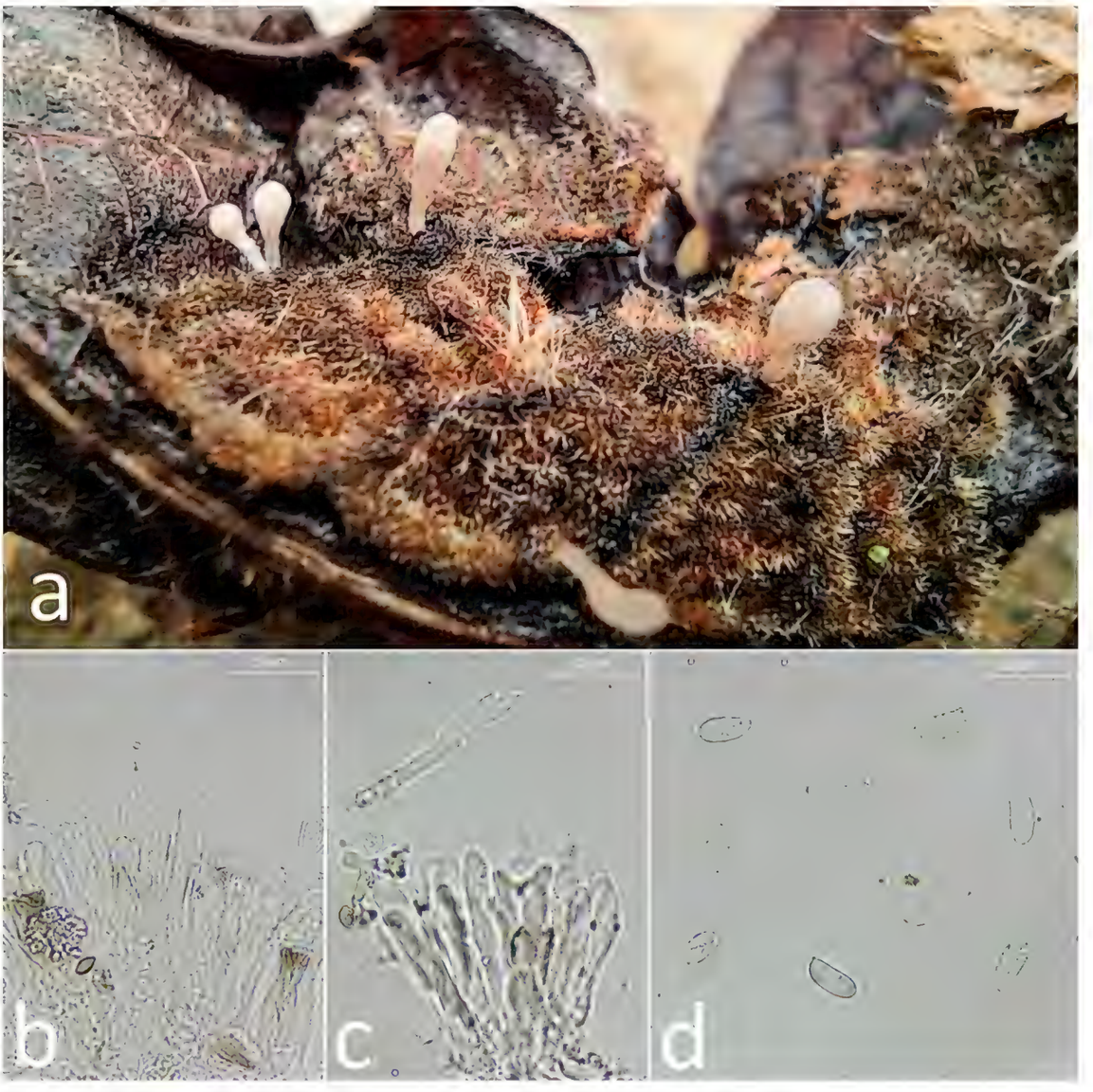

Fig. 6. *Typhula quisquiliaris* (VANF 7889):
a. Basidiomata; b. Basidia; c. Basidioles; d. Basidiospores.

T. spathulata is distinguished by its solitary growth on the ground or amongst moss and absence of clamps (Breitenbach & Kränzlin 1986, Wojewoda 2000, Buczacki & al. 2012, Hansen & Knudsen 1997).

Discussion

This study was conducted in one of the least studied areas of Türkiye in terms of macrofungi, and these areas have significant potential in determining the macrofungal diversity of Türkiye, which is well below the expected level. With our new records, the number of *Typhula* species reported from Türkiye is raised to eleven.

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